Designing A Station Pilot At Lagoon for Treatment of Wastewater

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Abstract

This study involves the design and sizing of a pilot wastewater treatment plant for the treatment of wastewater from the town Oulad Said the region Chaouia Ouardigha ***[1]****. The pilot plant designed for 10 Equivalent-Habitants, has been implemented based on the empirical formula of MARA* ***[2]****. It has three lagoon pools, an anaerobic pond, a facultative pond and a maturation pond. The result of reduction of the studied physico-chemical and bacteriological parameters indicates the well functioning of the optimized station.*

Key words: *wastewater, pilot station, impoundment, treatment.*

1. Introduction

With water stress currently affecting the world in general and the arid and semi-arid areas in particular; treatment and recycling of wastewater by different techniques are an alternative option to the possibility of availability of water resources. It is in this context that the present work is registered and aims the treatment and reuse of wastewater from a small town of 2500 people through the use of a pilot lagoon and to the design of the treatment plant wastewater Town station.

2. Materials and methods

Determination and followed indicators pollution parameters was carried out in part by the extent of microbiological parameters and secondly by measuring the BOD_5 (biochemical oxygen demand), COD (chemical oxygen demand) according to the standard **[3]** and other physicochemical parameters.

All measurements were performed according to the AFNOR standard **[4, 5]**. Microbiological analyzes were performed at the Pasteur's Institute in Casablanca.

The study was carried out with a pilot who consists of three ponds covered with a geo-membrane to provide sealing **[6]**. The pilot is sized to 10 Eq/hab using the following areas: anaerobic pond S(a) = 0.80 m^2, facultative pond S(f) = 11.24 m^2 and maturation pond S(m) = 5.27m^2

3. Results and discussion

a. Results of physicochemical and bacteriological parameters

Each pool was respectively supplied by a flow of wastewater of 753 liters / day for 32 days in accordance with the residence time in each tank.

The results of analysis of the various physicochemical and bacteriological parameters are shown respectively in Tables 1 and 2.

Table 1 : Abatement rate of physicochemical parameters

Parameter	Input to the pilot	output of the pilot	abatement%
pH	7.27	8.1	- - -
Cl^- (mg/l)	885,123	308,14	65
PO_4^{-2} (mg/l)	8,73	3,9	55.3
Mg^{+2}, Ca^{+2} (mg/l)	145,57	25,2	83.3
SO_4^{-2} (mg/l)	435,33	72,038	83.5
NO_3^- (mg/l)	8,19	2,39	70.8
NH_4^+ (mg/l)	9,994	49,6	
MES (mg/l)	492,86	126,5	74.3
Turbidity (NTU)	302,57	35,60	88.2
DCO (mg/l)	792,3	116,66	85.3
DBO_5 (mg/l)	357,5	60	83.2
TA (mg/l)	55	10	81.2
Conductivity (ms/cm)	4,1612	2,93	>30

Table 2 : Abatement rate of microbiological parameters

Parameter	Input to the pilot	output of the pilot	Abatement %
Germ Totals (cfu/ml)	123	0	100
Total coliforms (cfu/ml)	10.106	103	99.99
Fecal streptococci (U/100ml)	3.106	103	99.96

b. Phenotypic appearance of the pilot station

The phenotypic appearance of the water treatment plant produces a change in water color: to the input of the pilot water is turbid with a gray color and a pungent odor, at output of the pilot becomes greenish color with disappearance of foul smell, which is a first visual indicator of treatment.

c. Physicochemical parameters

The performance of the pilot plant was evaluated by calculating the abatement rates of main parameters indicative of pollution between the input and the output of the pilot. Concentrations at the exit of the pilot indicate a very significant abatement, except for some elements.

The pH showed a slight increase to the basic of 7.27 to 8.1. This change could be explained either by the dissociation of carbonic acid (H_2CO_3) from the hydration of CO_2 in carbonates (HCO^{3-}) when carbonic acid disappears as well as other acids generated in the waste water, or by the complexing with other oxide ions ($CaCO_3$, $CaSO_4$ ...).

The chlorides showed a reduction of 65%, this decrease may be due to the complexing of these ions in other chemical forms forming new compounds ($MgCl_2$, vinyl chloride: CH_2ClCH_2Cl, $CaCl_2$) **[7]** not to mention the involvement of chloride in the destruction of pathogens and bacteria generally.

Moreover, there is a reduction of 88.2% for turbidity, 74.3% for suspended solids and 85.3% for COD. This shows the ability of the pilot to eliminate the pollution load **[8]**.

d. Nutrients

The reduction rate of orthophosphate (55.3%) comes in a major portion of the mineral phosphorus excretions of organisms **[9, 10]** has decreased significantly, which could be argued by the assimilation of inorganic phosphorus by algae, or by combining with other elements (iron, calcium) and form insoluble compound ($CaPO_4$, $MgPO_4$, K_2PO_4) which precipitate at the sediment, or by absorption of these ions.

The reduction of NO_3^- could be explained either by denitrification of nitrate to atmospheric molecular nitrogen (N_2) which is optional or anaerobic denitrification, either by assimilation by autotrophic microorganisms (nitrifying bacteria) to derive energy, or as by reduction of ammonium NH_4^+ **[11]** (Table 1), it has evolved to 9.994 mg / l to 49.6 mg / l.

e. Microbiological parameters

Microbiological reduction recorded at the output of the pilot plant is almost 100% for all germs **[12, 13]**: Germs totals, total coliforms, fecal streptococci, and the absence of other germs pathogens (salmonella, vibrio) and the total absence of parasites represented by helminthes eggs. This justifies the reduction of chlorides which occurred in the inhibition of metabolic and bacterial activity. (Table 1)

f. The elements of metallic trace

The metal analysis was carried out to laboratories UATRS Rabat. The analysis results are presented in Table 3.

Table 3 : Reduction of the metallic elements before and after treatment

Element	Al	As	Cu	Fe	Ni	Pb
wastewater	0.065	0.006	0.021	0.143	0.005	0.009
Treated water	0.020	0.003	0.02	0.028	0.004	0.005
abatement %	69	56	3	80	30	46
RD (ONEP)	10	0.1	0.5	3	1	0.5
RI (ONEP)		0.1	1	3	1	0.5

According to the results we can see that the metal concentrations are below the values authorized by the standards **[14, 15]**. Therefore, they pose no health risk. These low levels justify the absence of industrial activities in the town. The only source of these elements could be the soil or water consumption of the population **[16]**.

The reduction of these elements is probably due to sedimentation in the form of oxides complexed with other elements or assimilated by zooplankton organisms **[17]**.

4. Conclusion

The COD/BOD_5 ratio is 2.6, it expresses the biodegradability of the effluent and it is at the upper limit of the range of domestic wastewater biodegradable.

The results of analyzes are very probative and show that the pilot plant conceived, allowed to obtain a good rate reduction for all physicochemical and microbiological parameters.

These results suggest that the treatment process by lagoon is ideally suited to the treatment of wastewater from the town and the treated water can be reused for irrigation

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